MATRIX$_X$ Automated Testing Tool

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This research program has focused on developing tools and techniques that can automate the process of testing and troubleshooting complex control systems that are implemented using an autocoder. Significant increases in software complexity and sophistication have made software more difficult to test and troubleshoot. Historically, the cost of debugging has been the most time-consuming and expensive aspect of large-scale software development. In order to increase software production efficiency, many real-time systems and controllers are being implemented with the code generated by automatic code generators, such as the MATRIX$_X$ SystemBuild from Integrated Systems, Inc. and SIMULINK Real Time Workshop from The Mathworks, Inc.

The MATRIX$_X$ Automated Testing Tool (MATT) was developed at East Tennessee State University to aid in the verification of systems implemented in the MATRIX$_X$ environment. The tool targets automation of black box techniques such as critical value testing, random input testing, cyclic value testing, and floating-point accuracy testing. MATT supports automated testing of MATRIX$_X$ models, at the superblock level, through a user friendly interface for both the Solaris and Windows platforms. This tool provides powerful support for the generation of test matrices, launching of simulation, capturing simulation results, and analyzing these results. Graphing is supported, as well as the ability to save test data for later reuse and save simulation results for regression analysis. MATT can literally generate thousands of tests, simulate those tests, and capture results in minutes. More than 20 test types are provided in addition to the ability to import user-created test data. A user simply selects a MATRIX$_X$ model, chooses a superblock, selects the number of tests, selects the test type for each input variable, creates an input matrix, launches a simulation, and analyzes the results through MATT Results and Summary screens. Graphs are easily created as well by simply choosing the input or output variables to graph and creating the graph in MATT.

In an era of highly ambitious technological goals critically dependent on real-time software, well-planned and effective testing strategies based on automation are needed to meet these goals. The MATT tool supports specification of a set of test types, strategies for applying these test types, and automated support for testing real-time systems built using MATRIX$_X$.

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Nanoelectronics Modeling

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Nanoelectronics research at Ames encompasses topics in molecular devices and miniaturization of conventional semiconductor devices. The objective is to acquire the knowledge necessary to build future generations of computing devices and sensors to fulfill NASA's challenges in aerospace transport and space missions. There were three significant accomplishments in FY99. First, we modeled electron transport in capped carbon nanotubes and gleaned the effect of caps and defects on electron emission, which is important in the use of the nanotubes as probe tips and wires. Second, through modeling and analysis we related conductance to mechanical deformation of carbon nanotubes, which is important in the use of nanotubes as sensors. Third, we developed a simulator for quantum mechanical transport in semiconductor devices, which provides important capability to study future generations of ultrasmall devices. A brief description of each follows.

The large length-to-diameter ratio of carbon nanotubes makes them good candidates for molecular wires and field emitters, and for use in probe-tip applications where electron emission from the tip of the capped tube is important. The results show that transmission probability mimics the behavior of the electronic density of states at all energies except the localized energy levels of a polyhedral cap (figure 1). The close proximity of a substrate causes hybridization of the localized state. As a result, subtle quantum interference between various transmission paths gives